SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechatronics Engineering (Hons.).

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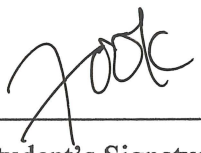
STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.



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WEATHER STATION ANALYSIS USING MICROCONTROLLER AND INTERNET OF THINGS (IOT)

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ABSTRAK

Pemantauan cuaca sangat berguna dalam pelbagai aplikasi seperti dalam sistem saintifik kritikal atau untuk tujuan simulasi. Peranti pengawasan cuaca merupakan sebuah peranti elektronik yang bersaiz kecil, mudah alih dan bebas beroperasi. Peranti pengawasan cuaca terdiri daripada Arduino Mega, modul Wi-Fi, dan sensor suhu. Parameter yang dikumpul terdiri daripada suhu udara dan kelembapan relatif di kawasan tertentu. Data yang dikumpul dari sensor akan digunakan untuk mengira suhu titik embun bagi menentukan persepsi manusia kepada keadaan cuaca semasa. Data yang dikumpul akan dihantar ke laman web Thingspeak, iaitu satu aplikasi Internet of Things (IOT) untuk memaparkan dan memantau data dalam bentuk graf. Data yang dikumpul menunjukkan nilai sebenar yang mewakili keadaan cuaca semasa bagi kawasan yang sedang diukur. Selain itu, hubungan antara suhu udara, kelembapan, dan suhu titik embun boleh ditentukan melalui peranti pengawasan cuaca. Dengan itu, persepsi manusia di kalangan rakyat Malaysia boleh ditentukan melalui suhu titik embun yang disertakan dalam projek ini.

ABSTRACT

The monitoring of weather is really helpful in various applications like in critical scientific systems or for simulation purposes. Weather monitoring device is a small size, portable and stand-alone electronic device. Weather monitoring device consists of Arduino Mega, Wi-Fi shield and a temperature sensor. The parameters collected were room air temperature and relative humidity of a particular area. Data collected from sensor will be used to calculate dew point temperature which is important to determine the human perception on current weather. The collected data will be sent to *Thingspeak*, an Internet of Things (IoT) website to display and monitor the data in the form of real-time graph. Collected data show accurate real-time values that represent the current weather condition of the area being measured. Besides, the relationship between room air temperature, relative humidity and dew point temperature can be determined. Lastly, the human perception among Malaysian on current weather condition can be determined through dew point temperature which is included in this project.

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LIST OF SYMBOLS

°C	Temperature in degree Celsius
e_s	Equilibrium vapour pressure over a plane of water
RH	Real-time relative humidity from sensor
%RH	Percentage of relative humidity
t	Real-time temperature from sensor
V_{out}	Voltage output of temperature sensor
V_{supply}	Voltage supplied

LIST OF ABBREVIATIONS

AADI	Aanderaa Data Instruments
ADC	Analog to Digital Convertor
CSV	Comma Separated Values
DNS	Domain Name System
DSP	Digital Signal Processing
GSM	Global System for Mobile
I/O	Input/Output
IoT	Internet of Things
IP	Internet Protocol
IRQ	Interrupt Request
LED	Light-Emitting Diode
MCU	Microcontroller Unit
PC	Personal Computer
SD	Secure Digital
SOC	System On a Chip
SPI	Serial Peripheral Interface
TCP	Transmission Control Protocol
TFT	Thin Film Transistor
UART	Universal Asynchronous Receiver/Transmitter
UDP	User Datagram Protocol
UFL	Upper Flammable Limit
UMP	University Malaysia Pahang
USB	Universal Serial Bus
WSN	Wireless Sensor Network

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Weather monitoring devices have been grown rapidly and important for human beings in various applications in the field of critical scientific systems or for simulation purposes. There are few parameters will affect the thermal comfort of human being, such as temperature, radiation, air flow, humidity, and clothing thermal resistance. These parameters are measureable weather elements. Sometimes the changes in climate will cause natural disasters to human being. To alert and protect human being from disasters that caused by the weather changes, weather measurement and monitoring tools are very useful.

Currently, weather monitoring devices that are having real-time alerting and reporting system on the varying environmental conditions become very important. Weather monitoring device is a stand-alone electronic device which is portable, small in size, powered by battery and able to collect data on a 24-hour operation. Acquisition, online analysis, logging, offline analysis, display and data sharing are the necessary requirements for a data logging system.

A microcontroller plays a major role in weather monitoring device. Microcontroller controls and converts electrical pulses from sensors which are analogue data into digital data to be recorded and stored on the storage device for further analysis.

The advantages of data loggers are based on the ability in few criteria i.e., work at very long intervals, portable, reliability, flexibility and robustness. Some of the criteria must be considered while choosing sensors such as size, speed/memory, real time operation and display. Speed is essential parameter due to the sampling rate from

the parameter changes. For a longer interval, a high memory is needed. Real-time capability is important for user to know the status of current parameters that are being measured. Thus, user will be able to take a proper action based on the device's real-time feedback. Users will be able to read the readings of all the parameters show on screen.

A wide-spread operation of data logging system can be found in our daily lives for example weather stations, in-out product flow in the industries, and attendance system in schools or universities. Due to independently and sensitivity variation of parameters in the data logger, human can be substituted out from the high risk job by replacing the data logging system. Furthermore, this system consists of real-time information and also stores the data for further analysis.

The direction of this project is to fabricate a low cost weather monitoring system that able to acquire, record and store the data which are accessed anywhere. The proposed system will measure three different parameters namely temperature, humidity and dew point temperature. Besides, the dew point temperature also useful in determine the human perception on weather based on Malaysia weather condition. The analog outputs of these sensors will be converted to digital signals through Analog to Digital Convertor (ADC) and further processed by a microcontroller which acts like a data logger. A Wi-Fi shield act as an interface medium to transfer and receive data collected from sensor to an open source Internet of Things (IoT) channel. Computer is used to access to the IoT website to monitor the real-time graph created on the channel. Besides, Thin Film Transistor (TFT) Display will display the real-time value of the sensor.

This weather station project can be considered as a platform for further applications in future. In other words, this system can be modified to fit more sensors to record different type of parameters for examples the ground chemical composition and soil parameters.

1.2 PROBLEM STATEMENT

Most weather measurement devices collect data and send to data loggers then transferred to a computer directly. They are not able to analyze and share the data through a wide electronic medium. In addition, the cost for that particular device is expensive while having a limited functionality. Most of the weather monitoring device that available in the market is too bulky, costly and difficult to capture the real-time data which are able to be accessed anywhere. Therefore, this project will propose some improvements and extensions on weather station in terms of size and cost of weather monitoring device. For example, the improvement for the size of weather monitoring device that currently available in the market that is too bulky. Besides, the cost of the weather monitoring device that is available in market is too expansive. Therefore, this project will help to reduce the cost of sensor used and cost of materials used in weather monitoring device. Moreover, this project not only can display data on the device but also can monitor the data worldwide through IoT channel. Besides, this weather monitoring device helps to determine human perception on weather condition based on dew point temperature.

1.3 OBJECTIVES

The goals for this project are as follow:

i. Monitoring and analyze temperature and relative humidity from the weather monitoring device.
ii. To determine human perception on weather condition through dew point temperature.
iii. To build a low cost weather monitoring device that provides world-wide and real-time data.

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